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GRASSHOPPER CONTROL

In Relation to Cereal and Forage Crops

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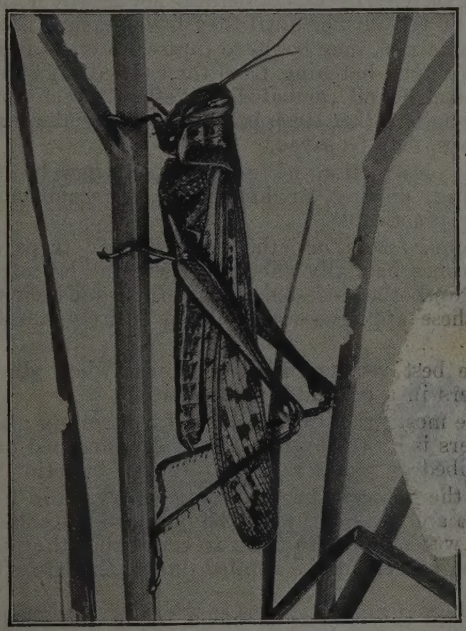

FARMERS' BULLETIN 747

UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from Bureau of Entomology
L. O. HOWARD, Chief

Washington, D. C. October, 1916

ALTHOUGH grasshoppers are not usually noticed by the farmer until they have reached a considerable size, they begin to injure his crops immediately upon hatching from the egg. They should be detected and combated, therefore, while young and small, so that time, labor, and material, as well as crops, may be saved.

The destruction of grasshopper eggs by fall plowing, disking, or harrowing is recommended where practicable.

Hopperdozers or other grasshopper traps are sometimes partially effective where the lay of the fields and other infested areas will permit their use, but these appliances are seldom entirely satisfactory.

The best results can be obtained when all the farmers in a community cooperate.

The most practicable means of controlling grasshoppers is by the application of the poisoned baits described on pages 15 and 16 of this bulletin.

In the semiarid parts of the country, as in California and the Southwest, the poisoned baits should have water added to them to counteract the rapid drying and should be applied during the late afternoon.

Where the climate is moist, as in the Eastern and Southern States, the baits may be prepared without the water and applied during the early morning hours.

GRASSHOPPER CONTROL IN RELATION TO CEREAL AND FORAGE CROPS.

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PRINCIPAL KINDS OF GRASSHOPPERS INVOLVED.

MANY kinds of grasshoppers are injurious to grains, grasses, and forage crops throughout the United States. The more important are the differential,[1] the two-striped,[2] the Carolina,[3] the lessor migratory,[4] the pellucid or clear-winged,[5] the red-legged,[6] the California devastating,[7] the southwestern lubber,[8] the Florida lubber,[9] and the New Mexico long-winged grasshopper.[10]

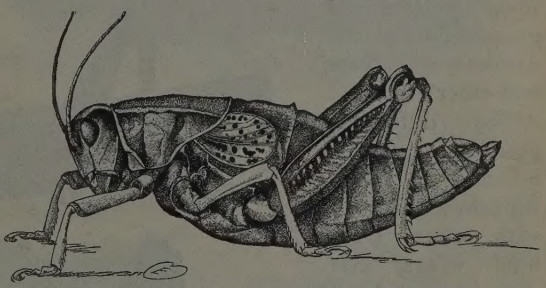

FIG. 1.—Southwestern lubber grasshopper (*Brachystola magna*): Adult female. Natural size. (Original.)

In the following pages is given a short description of these grasshoppers and the regions in which they occur, together with their life history, the crops attacked, and measures for controlling them.

The southwestern lubber grasshopper (fig. 1), a very large species, lives in the semiarid regions of the Southwest. It is usually pale green in color, speckled and marked with pink and brown, and is wingless throughout its entire life. It sometimes becomes injuriously abundant on the cattle ranges and dry farms of New Mexico and Arizona, but is found throughout the Great Plains region from

[1] *Melanoplus differentialis* Thom.
[2] *Melanoplus bivittatus* Say.
[3] *Dissosteira carolina* L.
[4] *Melanoplus atlanis* Riley.
[5] *Camnula pellucida* Scudd.
[6] *Melanoplus femur-rubrum* De G.
[7] *Melanoplus devastator* Scudd.
[8] *Brachystola magna* Gir.
[9] *Dictyophorus reticulatus* Thunb.
[10] *Dissosteira longipennis* Thom.

Wyoming and South Dakota to New Mexico and Texas. It is known to injure seriously corn, kafir, alfalfa, and grasses of various kinds.

The Florida lubber grasshopper (fig. 2) is a clumsy insect, often reaching the length of more than 2½ inches, and is correspondingly robust. It is usually yellowish in color, prettily marked with black, and its short and nearly useless wings are more or less distinctly stained with a bright crimson color. It inhabits the southern United States from North Carolina to Texas and has been especially injurious throughout the newly reclaimed regions in the State of Florida. It has been found to attack corn, grasses, sorghum, cowpeas, soy beans, and other crops.

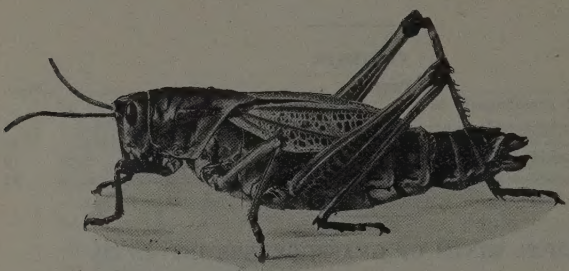

FIG. 2.—Florida lubber grasshopper (*Dictyophorus reticulatus*): Adult female. Natural size. (Webster.)

The differential grasshopper (fig. 3) is usually a yellowish-colored insect with clear glassy hind wings, averaging nearly 1½ inches in length. Its hind legs are usually distinctly marked with yellow and black, the colors arranged in chevron-shaped bars on the sides of the thighs. It is found throughout nearly the entire United States, although of rare occurrence in the Atlantic States. This grasshopper is chiefly injurious in the middle western and southwestern States, and is known to attack the following cereal and forage crops: Corn, sorghum, oats, wheat, bluegrass, soy beans, clover, and alfalfa.

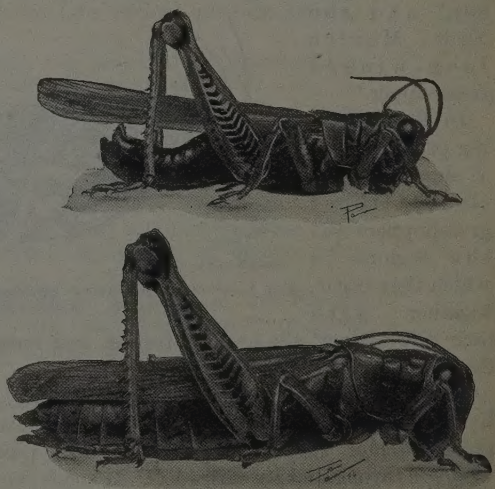

FIG. 3.—Differential grasshopper (*Melanoplus differentialis*): Above, adult male; below, adult female. Twice natural size. (Original.)

The two-striped grasshopper (fig. 4) is a compact, yellowish species, bearing, as its name implies, two yellow stripes running from the forehead down each side of the otherwise brown back. It varies from 1 to 1½ inches in length and its hind wings are nearly colorless. This species is found from southern Canada to Mexico, excepting the South Atlantic States, and is very injurious to such important crops as wheat, corn, grasses, alfalfa, and clover.

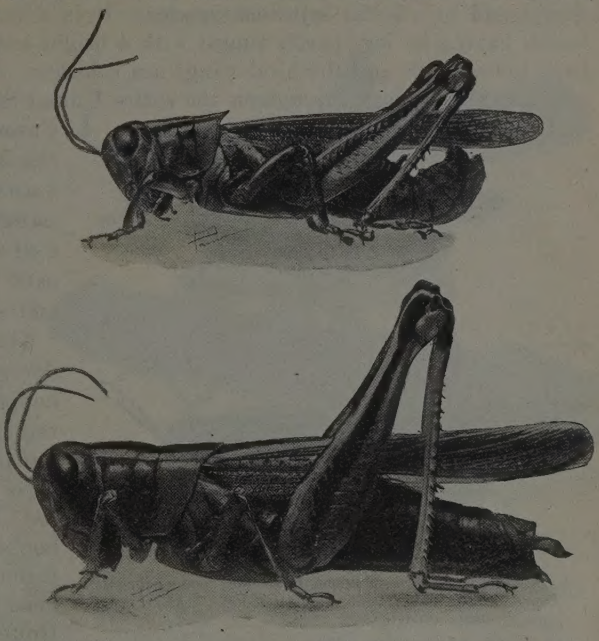

FIG. 4. — Two-striped grasshopper (*Melanoplus bivittatus*) : Above, adult male ; below, adult female. Twice natural size. (Original.)

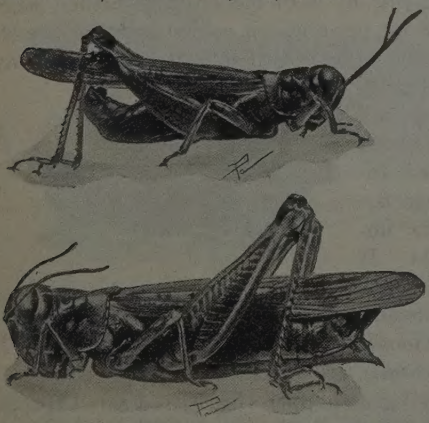

FIG. 5.—Lesser migratory grasshopper (*Melanoplus atlanis*) : Above, adult male ; below, adult female. About twice natural size. (Original).

The lesser migratory grasshopper (fig. 5) is a rather small, yellowish-gray species, averaging about 1 inch in length and bearing a distinct patch of black on the neck or collar. Although this grasshopper is comparatively small in size, it is a strong flier and sometimes does immense damage to alfalfa, grasses, timothy, corn, rye, soy beans, and wheat. It is found throughout nearly the entire United States, but is chiefly injurious in States west of the Mississippi River.

The red-legged grasshopper (fig. 6) is one of the most widely distributed of all the injurious species. It is a small, yellowish insect, having its legs partly tinged with a bright reddish hue. Its back is brownish and the hind wings are colorless. It is found in considerable numbers throughout the entire United States, southern Canada, and northern Mexico, and is known to injure seriously wheat, corn, bluegrass, oats, rye, timothy, and soy beans.

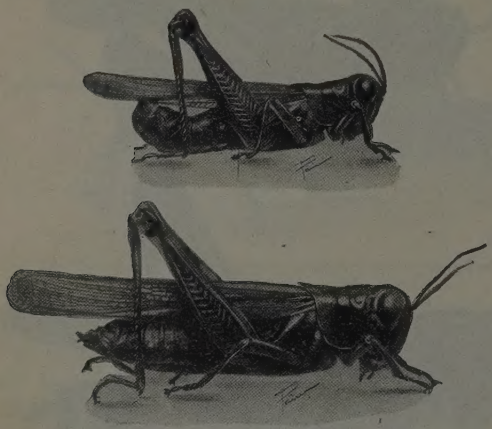

FIG. 6.—Red-legged grasshopper (*Melanoplus femur-rubrum*): Above, adult male; below, adult female. About twice natural size. (Original.)

The California devastating grasshopper (fig. 7) is a rather small species resembling somewhat the common red-legged grasshopper, but its injurious work is confined to the western United States, and especially California, where it frequently injures severely the alfalfa crop.

The Carolina grasshopper (fig. 8) is of moderate to rather large size, and is usually of a plain pepper-and-salt color, sometimes varying, in accordance with the soil upon which it is found, from gray through yellowish to a distinctly reddish color. Its hind wings are nearly black but are margined with yellow. Thus it is rendered inconspicuous while sitting upon the ground but catches the eye immediately upon taking flight. It is very widely distributed throughout the entire United States and is known to injure seriously corn, wheat, alfalfa, and soy beans.

FIG. 7.—California devastating grasshopper (*Melanoplus devastator*): Adult male. About twice natural size. (Original.)

The pellucid or clear-winged grasshopper (fig. 9) is a small species having its hind, or true, wings clear or pellucid, while the front wings are distinctly blotched with brown. It is at times one of the most injurious species found within the limits of the United States. It has been especially injurious in the States of Idaho, Utah, and California, but is also found in Arizona and New Mexico. It is dis-

tributed throughout the northern United States from the Atlantic to the Pacific. This grasshopper is known to injure oats, wheat, grasses, and occasionally flax.

The New Mexico long-winged grasshopper (fig. 10) is a large, strong-flying species, often measuring more than 2 inches in length and is yellowish-gray, marked with chocolate-colored spots. It is known to exist in the central United States, from Idaho and Montana to New Mexico and Texas, and at times has been exceedingly injurious to the native grasses on the cattle ranges of New Mexico.

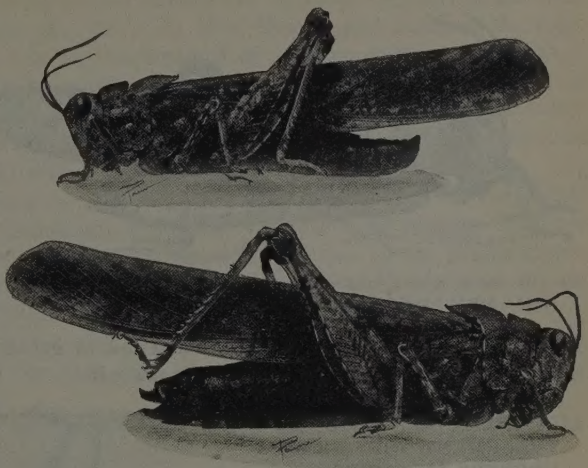

FIG. 8.—Carolina grasshopper (*Dissosteira carolina*): Above, adult male; below, adult female. About twice natural size. (Original.)

FIG. 9.—Pellucid or clear-winged grasshopper (*Camnula pellucida*): Adult female. About twice natural size. (Original.)

MANNER OF INJURY.

Grasshoppers, both young and old, injure crops in but one way, that is, by gnawing and devouring them wholesale, and where very numerous they have been known to consume almost every green thing in sight. Even the bark on the tender twigs of trees is eaten by these ravenous insects, which are known to gnaw the handles of agricultural tools, such as hoes and rakes, in order to secure the salt left upon them by the perspiring hands of the farmer.

CONDITIONS FAVORABLE TO OUTBREAKS OF GRASSHOPPERS.

It is generally believed in the middle and far western regions of the United States that when two dry summers occur in succession,

the second one usually produces serious outbreaks of grasshoppers. Whether or not this be true, there is ample evidence to show that dry weather favors the successful hatching of the eggs and the subsequent development of these pests. On the other hand, cool wet weather is unfavorable, and grasshoppers often die in great numbers from disease when such weather conditions prevail.

FIG. 10.—New Mexico long-winged grasshopper (*Dissosteira longipennis*): Adult female. About one-third enlarged. (H. E. Smith.)

LIFE HISTORIES AND DEVELOPMENT OF GRASSHOPPERS IN GENERAL.

FIG. 11.—Sac, or "pod," of grasshopper eggs in the ground. Slightly enlarged. (Original.)

The life histories of the various species of injurious grasshoppers are quite similar in character. The eggs are usually deposited in the soil, inclosed in sacs, or "pods" (fig. 11), formed of a glutinous substance furnished by the female. The grasshopper thrusts her tail or abdomen, which is capable of considerable extension, into the soil (fig. 12) and starts laying her eggs at the farther end of the tunnel thus formed, which is then filled with eggs and afterwards sealed. One grasshopper sometimes deposits a great many eggs. In the semiarid portions of the country, where the soil frequently becomes baked and hardened by the sun, the eggs are often laid in great numbers in the crowns of plants such as

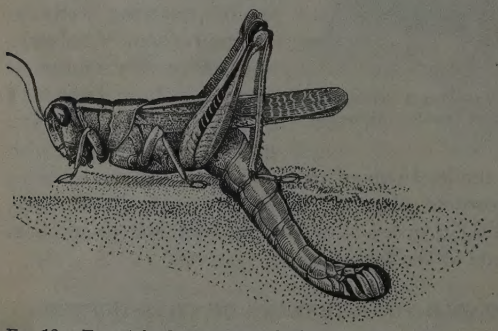

FIG. 12.—Two-striped grasshopper laying her eggs. (Webster.)

alfalfa, and in California as many as 2,000 eggs have been found in the crown of a single alfalfa plant.

The banks of irrigation canals are favorite egg-laying grounds for grasshoppers (fig. 13). In New Mexico and Arizona the eggs frequently are laid in the bottoms of shallow arroyos where they are inaccessible to cultivating implements. The waste lands of Idaho, Washington, and some other Northwestern States afford other instances where the destruction of grasshopper eggs is not practicable on a commercial scale.

The egg laying usually takes place in late summer or early fall and the young grasshoppers emerge the following spring. In some of the Southern and Southwestern States the young grasshoppers may emerge as early as February. In the North the eggs usually do not hatch until some time during the months of May or June.

In contrast with many other injurious insects, grasshoppers when hatched closely resemble their parents, excepting their lack of wings

FIG. 13.—An irrigation canal right of way where crowns of alfalfa plants contain thousands of grasshopper eggs to the square foot. (Webster.)

(fig. 14). There is no grublike larval stage nor is there any resting or true pupal stage such as is the case with butterflies and moths. The young grasshoppers are active and able to hop almost immediately upon emergence from the eggs. It takes from 70 to 90 days for the young grasshoppers to grow to maturity and develop wings. The farmer should therefore endeavor to attack the pest during its young stages, as this method not only requires less labor and material, but the insects can not then escape destruction by flying to untreated fields as they may, and often do, upon becoming mature. When the grasshopper reaches a certain stage of development its skin splits and is shed, the insect usually acquiring wings during the operation. It has then reached its final stage of growth and is ready to mate and reproduce its kind. So far as known the injurious species of grasshoppers have only one generation a year.

NATURAL ENEMIES OF GRASSHOPPERS.

INSECT ENEMIES.

Several kinds of parasitic two-winged flies deposit their eggs or maggots upon grasshoppers in their mature or nearly mature stage.

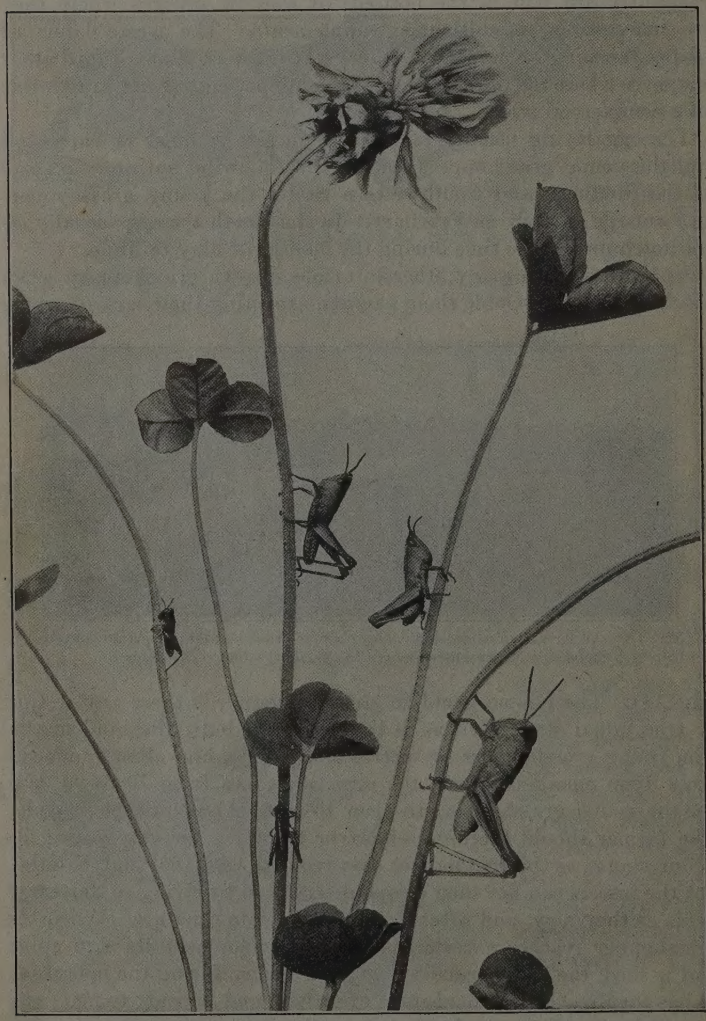

FIG. 14.—Young grasshoppers feeding on clover. Slightly enlarged. (Original.)

Among the most important of these is a blowfly or meat fly (fig. 15), which has been observed to deposit live maggots upon the wings of

the grasshoppers while they are in flight. The maggot of this parasite devours the internal portions of the grasshopper's body and soon causes its death. Robber flies (fig. 16) feed very largely upon young grasshoppers, grasping them in their long, stout legs, thrusting the strong beak through the body wall of the grasshopper and sucking out the liquid contents of the body. Several kinds of digger wasps (fig. 17) kill or stupefy grasshoppers by stinging, and then drag them into their underground nests, after which the wasp lays an egg upon the body of the grasshopper, which subsequently becomes food for the newly hatched grub. A number of blister beetles are known to prey in their younger stages upon the eggs of grasshoppers, but

FIG. 15.—A two-winged fly, *Sarcophaga kellyi*, parasitic on grasshoppers: Adult. About six times natural size. (Kelly.)

as the adult beetles are sometimes quite injurious to potatoes, beans, and other cultivated plants, they can not be considered as entirely desirable allies of the farmer.

WILD AND DOMESTIC BIRD ENEMIES.

The Bureau of Biological Survey has found that wild birds play a great part in the natural control of grasshoppers. These feathered friends of man are always present where grasshoppers abound and work almost constantly in aiding the farmer. The statement that all birds feed upon grasshoppers is so near the absolute truth that it needs only insignificant modifications. From the largest hawks to the tiny hummingbirds there are no exceptions other than the

strictly vegetarian doves and pigeons. Although birds of all families prey upon grasshoppers, the following may be selected as the most important destroyers of grasshoppers for their respective groups: Franklin's gull, bobwhite, prairie chicken, red-tailed, red-shouldered, broad-winged, and sparrow hawks, the screech and burrowing owls, yellow-billed cuckoo, road-runner, nighthawk, red-headed woodpecker, kingbird, horned lark, crow, magpie, red-winged and crow blackbirds, meadowlark, lark bunting, grasshopper and lark sparrows, butcher bird, wren, and robin.

FIG. 16.—A robber fly, *Promachus vertebratus*, which preys upon young grasshoppers: Adult. About three times natural size. (Original.)

Domestic fowls are also very fond of grasshoppers and feed greedily upon them whenever possible. Turkeys are sometimes killed by eating too freely of grasshoppers, the strong, rough hind legs of which cause severe lacerations or even puncturing of the crops of the birds.

HISTORICAL.

There exists ample evidence showing that grasshoppers, or locusts, as they are most often called in the Old World, have been reckoned among the principal insect enemies of agriculture since man began to till the soil. The writings of the Egyptians, Greeks, and ancient Hebrews all contain references to these insects as hateful pests of

the farmer. In North America unmistakable representations of grasshoppers are found on pottery and in the picture writings of the prehistoric Indians and Aztecs. It is therefore quite probable that grasshoppers attacked the maize and other crops of the Indians long before the coming of the white man. The early history of the New England States affords numerous records of the inroads by grasshoppers upon the crops of the settlers. During the period 1743 to 1756 a great scourge of these hungry insects occurred in Maine, and other outbreaks occurred in Vermont during the year 1797 to 1798. When agriculture began to be established generally in the Great Plains region of the United States, lying west of the Mississippi River and east of the Rocky Mountains, during the decade 1870–1880 a migratory species of grasshopper, commonly known as the Rocky Mountain locust,[1] frequently swooped down from its breeding grounds on the benches of the mountain range in such great swarms as to destroy practically all cultivated crops over vast areas of country. As the settlement of the Rocky Mountain region progressed and the breeding grounds of this destructive insect came under the influences of cultivation these outbreaks ceased. Thus, there has not been a serious general outbreak of the Rocky Mountain locust since 1880, and this particular grasshopper has ceased to be a pest of any great importance.

FIG. 17.—A digger wasp, *Priononyx atratus*, which kills or stupefies grasshoppers by stinging them, and carries them into its nests as food for its young. Nearly three times natural size. (Original.)

However, there are many other kinds of grasshoppers having different habits which have since hampered the farmer and undoubtedly will continue to rob him of his crops for years to come unless persistent concerted action of agricultural communities in combating these pests succeeds in securing permanent relief.

[1] *Melanoplus spretus* Uhl.

CONTROL MEASURES.

There are three principal methods of control which have been found to be of greater or less practical value in combating grasshoppers in this country: First, the destruction of the eggs; second, catching the insects in the field by means of traps; and, third, the use of the poisoned baits.

DESTROYING THE EGGS OF GRASSHOPPERS.

It is seldom practicable to destroy the eggs because of the many different hiding places chosen by the grasshoppers in laying them and the impossibility of reaching the same with cultivating implements. However, where they are accessible the ground containing them should be thoroughly plowed, or disked, and harrowed in the fall, as these operations prevent the eggs from hatching successfully the following spring. Attempts to reach the eggs by handwork,

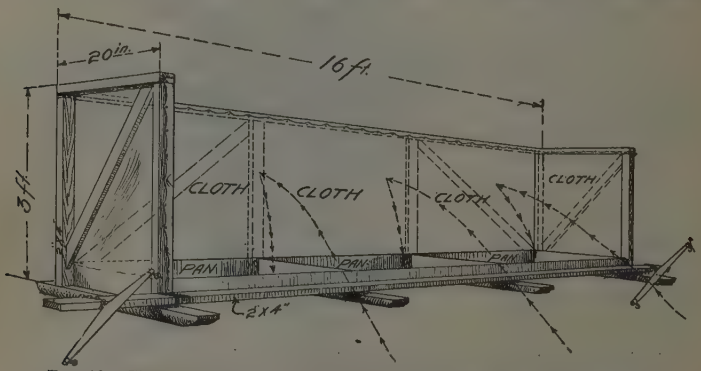

FIG. 18.—Hopperdozer with cloth back, showing construction. (Original.)

such as digging up the soil, is practicable only in gardens, truck farms, and places where intensive cultivation is practiced.

MECHANICAL MEANS OF DESTROYING GRASSHOPPERS.

The most common method of destroying grasshoppers mechanically is by the use of a simple horse-propelled implement or trap commonly called a hopperdozer. These implements are constructed along similar lines, but are of many slightly different patterns. As originally built the hopperdozer consisted of a galvanized sheet-iron pan or trough having a back rising at right angles to the pan. It was about 16 feet in length and mounted on runners made of wood or old wagon tires. Most of the hopperdozers recently constructed have a pan made of galvanized sheet iron, but the back and side wings are usually built with a wooden frame covered with stout muslin or light cotton duck, thus securing lightness and elasticity of structure. (Fig. 18.) The pan of the hopperdozer is kept partially filled with

water, upon which a film of low-grade kerosene, or coal oil, is maintained. When the implement has a cloth back and wings, these are kept moistened with kerosene oil. As the hopperdozer is drawn over the ground the grasshoppers jump or fly against its back and most of them are precipitated into the oil-covered water in the pan. A slight touch of oil is fatal to the insects. Thus, those that merely touch the oil-soaked back of the hopperdozer are usually killed, although they may not die immediately. The cheapest procurable grade of kerosene oil is perfectly satisfactory for use in a hopperdozer. An implement of this kind has been constructed recently with a back curving slightly forward. (Fig. 19.) The back and sides of this implement are covered with tin, nailed to furring strips carried by the uprights of the frame. It has been used successfully in western States, and it is claimed that the slight curve of the back and the slippery surface of the tin aid in precipitating the grass-

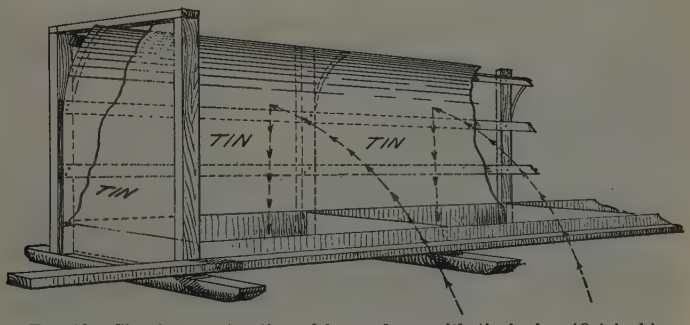

FIG. 19.—Showing construction of hopperdozer with tin back. (Original.)

hoppers into the pan. As many as 300 bushels of grasshoppers have been collected by the use of hopperdozers on 100 acres of alfalfa. But even where these implements may be used successfully, a great many grasshoppers escape being killed by them, and the fact that hopperdozers can not be used on uneven, stony, or recently cleared, stumpy ground, nor in meadows or fields of grain where the crops have reached a considerable height, makes it imperative that some more effective method of control be applied, and the poisoned baits have been found to supply this need satisfactorily.

POISONED BAITS AS A MEANS OF GRASSHOPPER CONTROL.

The mixture known as the poisoned-bran bait has been proven to be a simple, reliable, and cheap method of destroying grasshoppers, and has been applied with signal success throughout many portions of the United States. As prepared for ordinary use this bait is composed as follows: Wheat bran, 25 pounds; Paris green, 1

pound, or white arsenic, 1 pound; lemons or oranges, 6 finely chopped fruits; low-grade molasses, such as refuse from sugar factories, or cattle molasses, known as "black strap," 2 quarts. The bran and Paris green or other arsenical are thoroughly mixed while dry, the fruits are then finely chopped and added, and lastly the molasses is poured over the bait and the whole thoroughly kneaded. A coarse-flaked bran is most desirable, although where this can not be obtained easily ordinary middlings or alfalfa meal may be substituted; a low-grade, strong-smelling sirup or molasses, however, is essential to the entire success of the undertaking. Crushed ripe tomatoes, watermelons, or limes may be substituted for the lemons or oranges, if necessary. Ordinary powdered white arsenic (arsenious acid) contains nearly twice as much arsenic as Paris green and is comparatively low in price. The powdered form of arsenate of lead may be used, but in this case twice as much of it must be used

FIG. 20.—Sowing poisoned-bran bait from a buggy, in treating meadows to destroy grasshoppers. (Webster.)

as of the Paris green. In California and other semiarid regions water should be added to the bait at the rate of 4 gallons to 25 pounds of bran, as in these climates the bait dries out very rapidly and the extra moisture is necessary in order to attract the grasshoppers.

Another effective bait of similar character is the modified Criddle mixture. This is prepared as follows: Fresh horse droppings, one-half barrel; Paris green, 1 pound, or powdered white arsenic, 1 pound; finely chopped oranges or lemons, 6 to 8 fruits. This bait must be thoroughly mixed before being distributed and as most people object to handling this mixture with the bare hands, a pair of cheap rubber gloves may be used for the purpose. Both the poisoned-bran bait and the modified Criddle mixture are distributed over the infested fields by sowing broadcast, either on foot or from a light wagon or buggy, as shown in figure 20. A broadcast grain seeder

mounted on a wagon (fig. 21) has been used successfully for this purpose in the western portions of the country.

In applying the poisoned-bran bait in orchards, care must be taken to avoid distributing it close to the trees, because severe injury to fruit trees occasionally results from such applications of arsenical poisons.

Proper time for applying the poisoned baits.—The time of day chosen for distributing the poisoned baits has an important bearing upon the results secured. In California and other semiarid regions the bait should be distributed in late afternoon or early evening, just before the grasshoppers ascend the plants on which they usually pass the night. They are apparently hungry and thirsty at this time and greedily take the bait if it be available. In the moister portions of the country, such as New England and Florida, the bait is best applied early in the morning in order that the best results be secured. Farmers should not be discouraged if the grasshoppers do not drop dead immediately upon eating the poison, as it usually takes from one to five days for the full effect of the baits to become apparent.

FIG. 21.—Sowing poisoned-bran bait for grasshoppers by means of a broadcast grain seeder. (Webster.)

SUMMARY OF CONTROL MEASURES.

1. The most important and by far the most practicable means of controlling grasshoppers is by the application of the poisoned baits described on pages 15 and 16 of this bulletin. A strong effort should be made to apply these remedies when the grasshoppers are young, thus saving labor and material and therefore money. In the semiarid climates the baits should be applied during the late afternoon hours and should have water added to them as mentioned above. In moist climates, such as obtain in the Eastern and Southern States, the baits may be prepared without the additional water and applied during the early morning hours.

2. Where the topography of the infested fields will permit, the use of hopperdozers or other grasshopper traps is sometimes partially effective, but these methods are not often wholly satisfactory.

3. The destruction of eggs by fall plowing, or disking, and harrowing is recommended where practicable.

4. If the best results are to be obtained, the cooperation of communities is essential.

PUBLICATIONS OF U. S. DEPARTMENT OF AGRICULTURE RELATING TO INSECTS INJURIOUS TO CEREAL AND FORAGE CROPS.

AVAILABLE FOR FREE DISTRIBUTION BY THE DEPARTMENT.

Common White Grubs. (Farmers' Bulletin 543.)
The Larger Corn Stalk-borer. (Farmers' Bulletin 634.)
The Chalcis-fly in Alfalfa Seed. (Farmers' Bulletin 636.)
The Grasshopper Problem and Alfalfa Culture. (Farmers' Bulletin 637.)
The Hessian Fly. (Farmers' Bulletin 640.)
Alfalfa Attacked by the Clover-root Curculio. (Farmers' Bulletin 649.)
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